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(54) Abstract Title

Cooling an electric washing machine motor

(57) An electric motor 20 includes a stator 21 and a dish shaped rotor 22 disposed around the stator, the rotor having vanes 92 projecting from the inner surface of the rotor and extend radially for directing air to the stator.

The selective coupling 30 actuated from the drain valve motor for the spin/washing modes comprises a toothed member 50 which can be translated along the spin shaft 40 by cam slots 61 to engage brake teeth 59 or drive teeth 74, the agitator shaft 45 passing through shaft 40 to engage in coupler 73.

FIG. 2

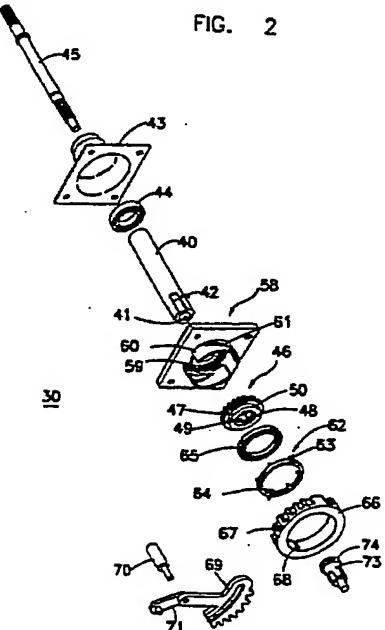
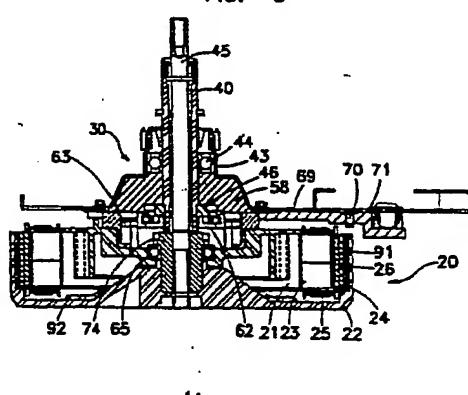
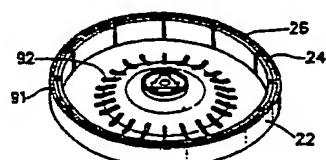


FIG. 3



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FIG. 4



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FIG. 1

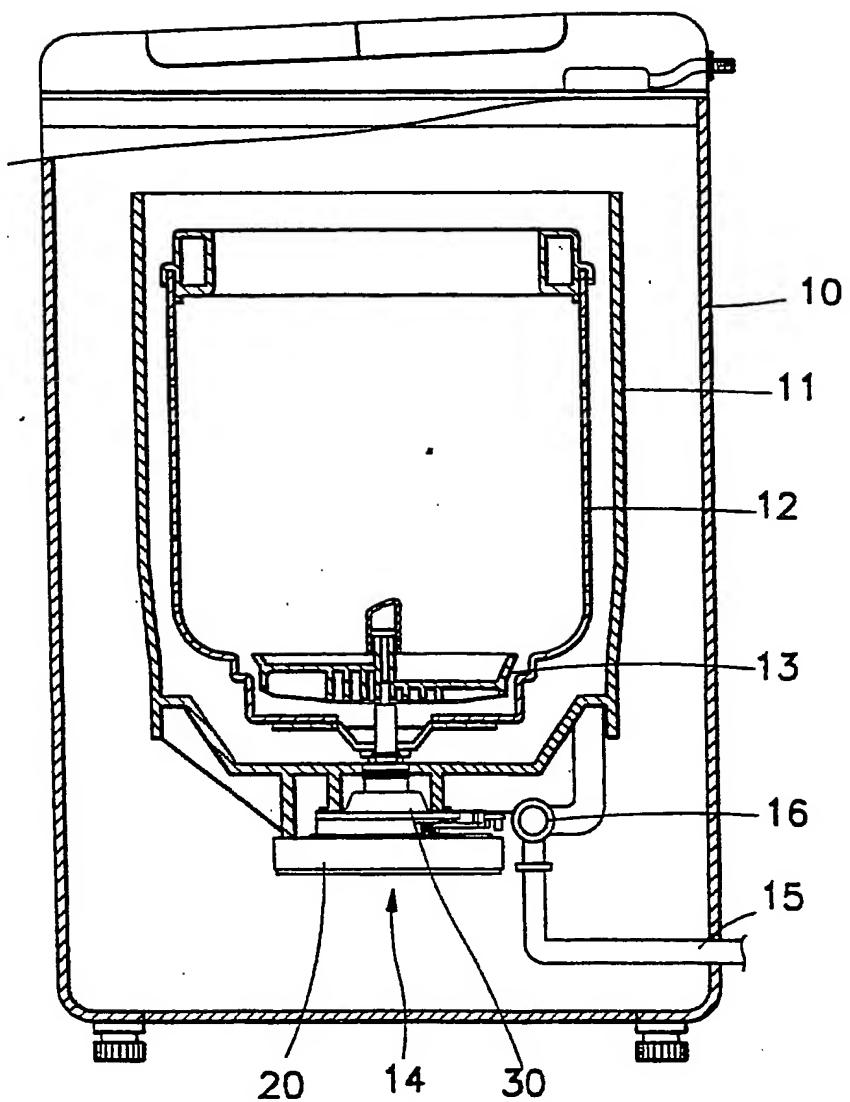


FIG. 2

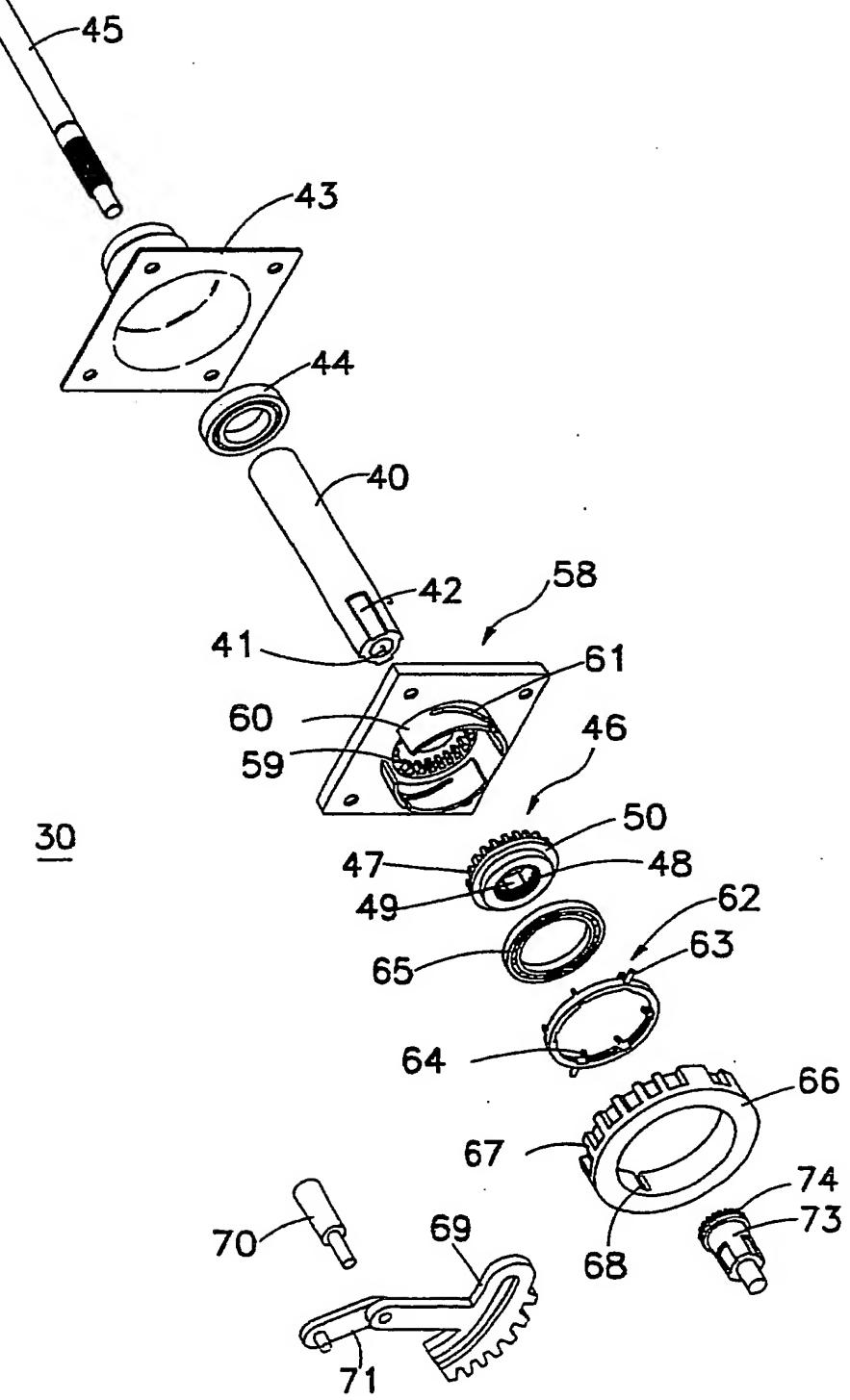


FIG. 3

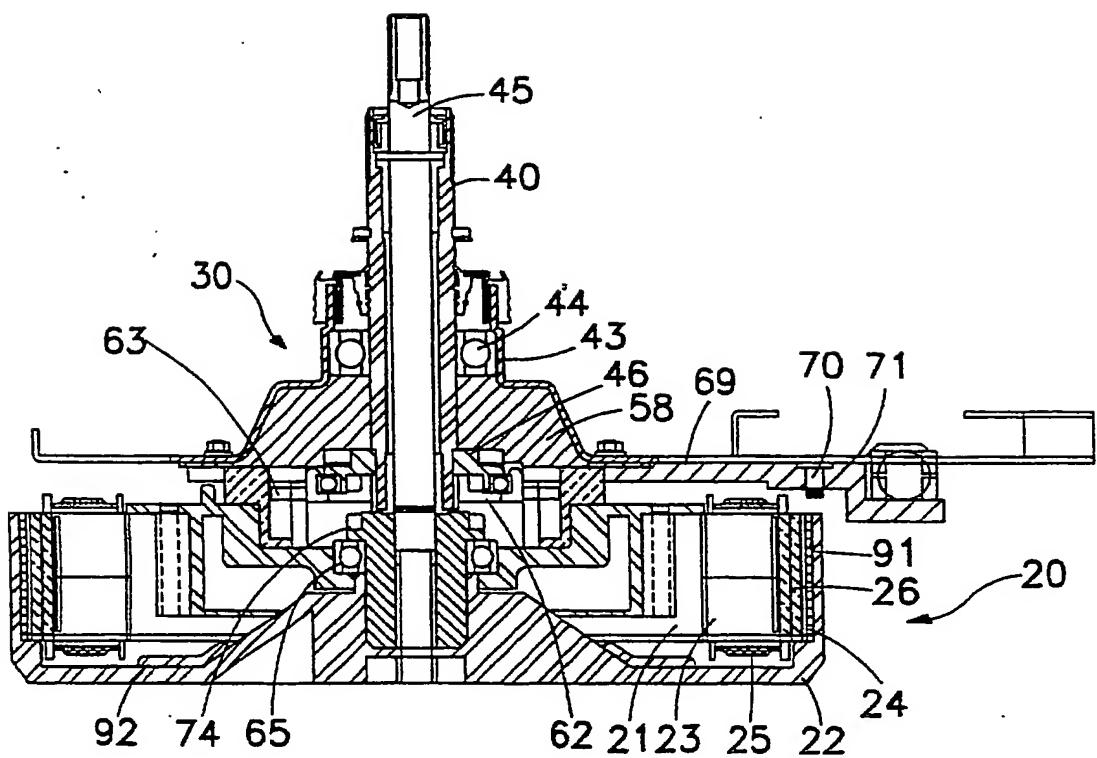


FIG. 4

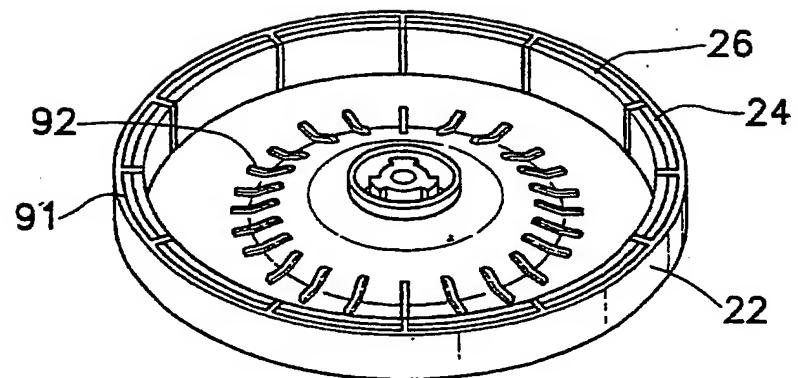


FIG. 5

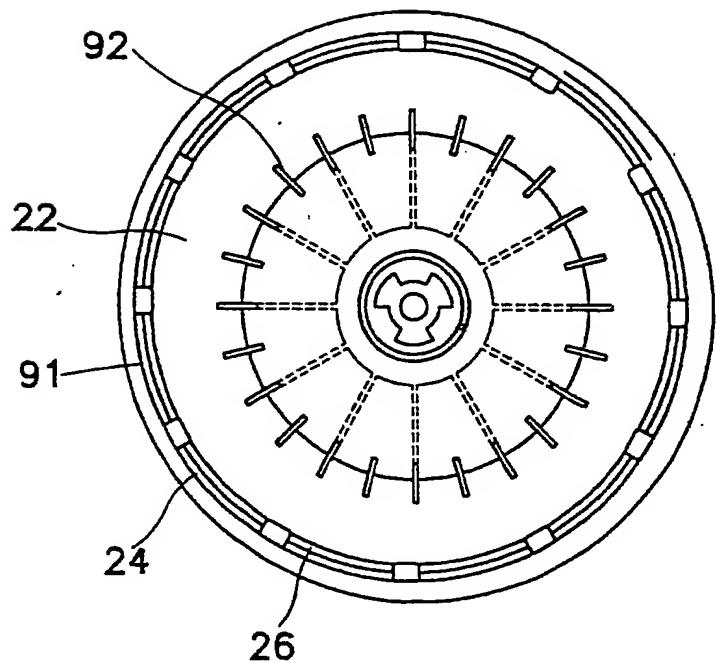
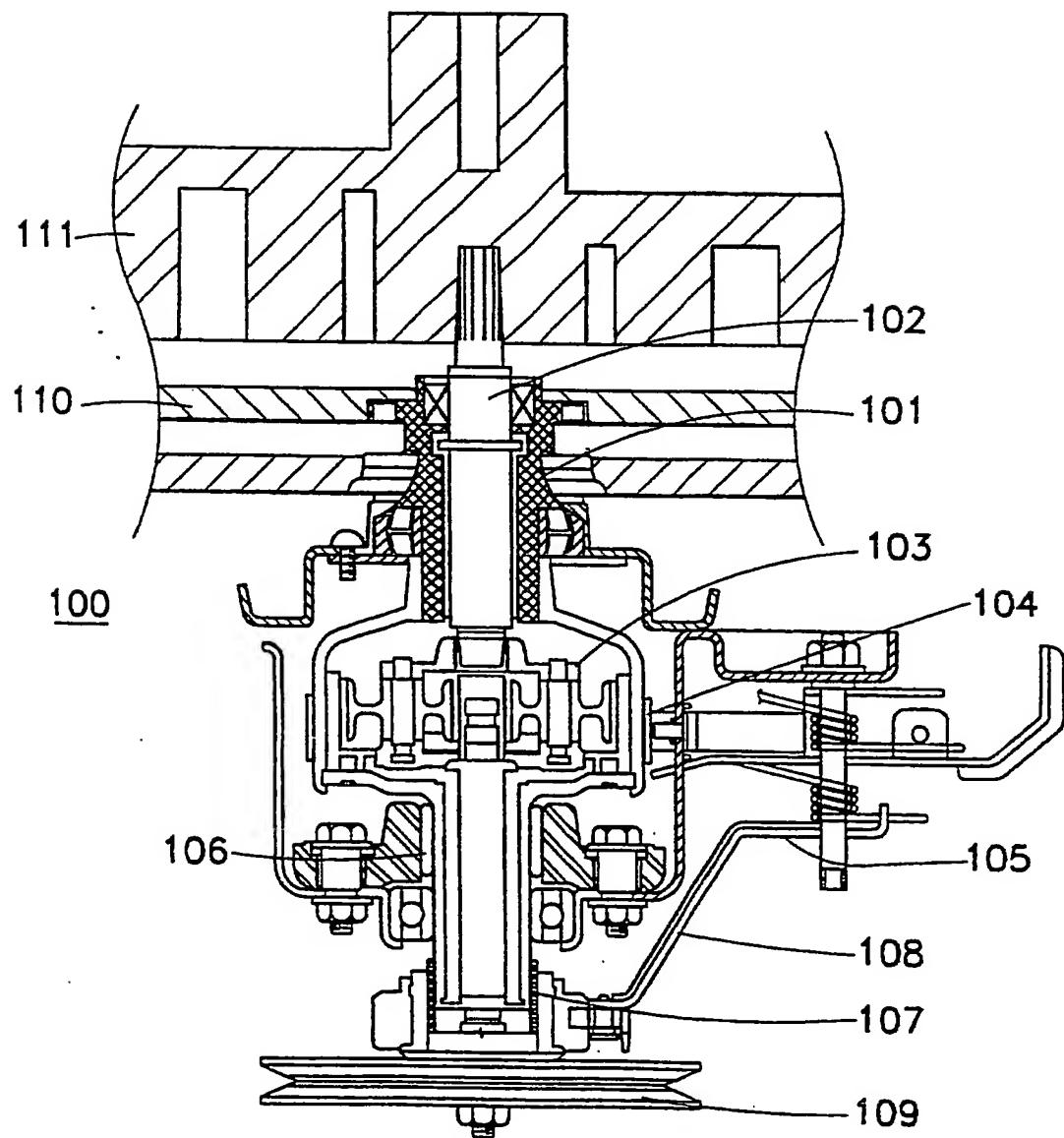


FIG. 6
(PRIOR ART)



Electric Motor

Description

The present invention relates to an electric motor.

5

Generally, a washing machine includes a main body defining its outer configuration, a tub installed within the body, and a spin basket and an agitator mounted within the tub. A drive system for the spin basket and the agitator is mounted under the tub.

10 The drive system typically comprises a motor, a transmission, and a belt for connecting the motor to the transmission.

Referring to Figure 6, a conventional drive system comprises a transmission 100 and a drive motor (not shown). The transmission 100 comprises a hollow spin-mode shaft 101 and a wash-mode shaft 102 coaxially within the hollow spin-mode shaft 101. The wash-mode shaft 102 is divided into upper and lower halves, with a planetary gear unit 103 being disposed therebetween. The planetary gear unit 103 changes the rotational speed of the transmission 100.

15

20 A brake band 104 and a brake lever 105 are disposed beside the spin-mode shaft 101 to brake the rotation of the spin-mode shaft 101, and a one-way bearing 106, for suppressing an idling of the spin basket 110 by cooperating with the brake band 104 and permitting the spin-mode shaft 101 to rotate in only one direction, is mounted on an outer circumference of the spin-mode shaft 101. In addition, a clutch spring 107 and a clutch lever 108 for transmitting/interrupting power from the motor to either the spin-mode shaft 101 or the wash-mode shaft 102 are mounted under the one-way bearing 106. A pulley 109, which a belt (not shown) engages, is mounted on a lower end of the wash-mode shaft 102.

25

30 In this conventional transmission 100, torque produced by the motor is selectively transmitted to the agitator 111 or the spin basket 110 through the clutch spring 107,

thereby performing washing and spin-drying operations. To achieve this, it is necessary that the clutch spring 107 has a high degree of tensile strength to enable the transmission or interruption of drive from the motor to either the spin-mode shaft 101 or the wash-mode shaft 102, both of which are rotated at a high speed. However, 5 the manufacturing process for such a spring is complicated, and, as a result, manufacturing costs are undesirably high.

In addition, the brake band 104 is, when it brakes the spin basket 110 in one direction, subjected to high forces generated when the inertia of water in the tub is 10 forcing the spin basket 110 to rotate. The above described one-way bearing 106 must additionally be used as a result, making the structure complicated and increasing manufacturing costs. Finally, an unpleasant noise is generated during the braking operation of the brake band.

15 As described above, a conventional power system of a washing machine is complicated with regard to the arrangement of parts for performing washing, spin-drying and braking operations, making it difficult to manufacture the same and increasing manufacturing costs. In addition, because of the large number of parts needed for this complicated arrangement, much space is required which, in turn, acts 20 to increase the overall size of the washing machine.

As a solution to this problem, there has been proposed a direct-coupled washing machine, in which the transmission is directly connected to the motor. A brushless direct current motor is used for the direct-coupled washing machine. The brushless 25 direct current motor is reversible and capable of increasing and decreasing its rotational speed.

The brushless direct current motor is designed to operate by electromagnetic induction between a stator coil of a stator and magnets mounted on a rotor. 30 However, when the motor is operated, variable magnetic force acts on the core of the stator, generating eddy currents and causing hysteresis losses. The eddy currents and

the hysteresis losses result in heating of the stator, and, if the stator becomes overheated, the efficiency of the motor deteriorates, reducing the life span of the motor.

According to the present invention, there is provided an electric motor, for instance a
5 brushless dc motor, comprising a dish-shaped rotor and a stator located within the rotor, wherein the rotor is provided with vane means for directing cooling air to the stator.

10 Preferably, the vanes are arranged about the axis of rotation of the rotor and each vane projects axially from the rotor and has a major face directed tangentially with respect to the axis of rotation of the rotor.

15 Preferably, the rotor comprises a disc portion having an axially extending wall around its circumference and the vanes project from the disc portion.

A motor according to the present invention may be employed in a washing machine including a tub, a spin basket within the tub, an agitator and transmission means for transferring drive from the motor to the spin basket and the agitator.

20 An embodiment of the present invention will now be described, by way of example, with reference to Figures 1 to 5 of the accompanying drawings, in which:-

Figure 1 is a side sectional view of a washing machine;

Figure 2 is an exploded perspective view of a drive system;

Figure 3 is a sectional view of the drive system of Figure 2;

25 Figure 4 is plan view showing a rotor of a motor;

Figure 5 is a perspective view of the rotor of Figure 4; and

Figure 6 is a sectional view of a conventional drive system.

30 Referring to Figure 1, a washing machine comprises a main body 10 defining the outer configuration of the washing machine and a tub 11 installed inside the main body 10. A spin basket 12, inside of which laundry is washed, is provided inside the

tub 11. Installed at the bottom of the spin basket 12 is an agitator 13 which rotates in clockwise and anti-clockwise so as to generate water currents.

A drive system 11, for driving the agitator 13 and the spin basket 12, is installed
5 under the tub 11.

The drive system 11 comprises a reversible motor 20 and a transmission 30, which transmits drive from the reversible motor 20 to the agitator 13 or the rotating spin basket 12.

10 The transmission 30 is structured such that drive from the motor 20 can be transmitted to the agitator 13 or, during spin-drying, to both the agitator 13 and the spin basket 12.

15 A drain hose 15 is mounted on the right side (as shown in the drawing) of the tub 11. The drain hose 15 drains water from the tub 11 to the outside of the main body 10. A drain valve 16 for opening and closing the drain hose 15 is mounted on the drain hose 15. A drain motor (not shown), which controls the operation of the drain valve 16, is mounted between the drain valve 16 and the transmission 30.

20 Referring to Figures 2 and 3, the transmission 30 comprises a spin-mode shaft 40 having a hollow section 41 and coupled at its upper portion to the spin basket 12. The spin-mode shaft 40 passes through the bottom of the tub 11 and a coupling plate 43, mounted on the bottom surface of the tub 11, for supporting the spin-mode shaft 40. A bearing 44 is interposed between the coupling plate 43 and the spin-mode shaft 40 so as to provide free-rotation therebetween.

25 The transmission 30 further comprises a wash-mode shaft 45 inserted into the spin-mode shaft 40, an upper end of which is coupled to the agitator 13 and a lower end of which is coupled to a rotor 22 of the reversible motor 20.

A ring-shaped connecting gear 46 is slidably located around the spin-mode shaft 40 so as to selectively connect the spin-mode shaft 40 to the wash-mode shaft 45. When the connecting gear 46 is lowered, the spin-mode shaft 40 rotates together with the wash-mode shaft 45, and when it is raised, only the spin-mode shaft 40 is rotated.

5

A coupling gear 53 which is designed to rotate with the reversible motor 20 is mounted on the lower end of the wash-mode shaft 45. The coupling gear 53 engages the connecting gear 46 when the connecting gear 46 is lowered.

- 10 The connecting gear 46 is provided with internal teeth 48, formed on an inner lower portion thereof, and external teeth 47, formed on an outer upper portion thereof. A plurality of guide projections 49 are formed above the internal teeth 48. The guide projections 49 are formed to correspond to a plurality of guide grooves 42 formed on the lower end of the spin-mode shaft 40, such that the guide projections 49 of the
- 15 connecting gear 46 can be inserted into the guide grooves 42 of the spin-mode shaft 40, thereby making it possible for the guide projections 49 to slide in the guide grooves 42.

- 20 A fixing plate 58 is coupled on the outside of the bottom of the tub 11. The fixing plate 58 is provided with internal teeth 59 that mesh with the external teeth 47 of the connecting gear 46 when the connecting gear 46 is raised, thereby suppressing the rotation of the spin-mode shaft 40.

- 25 To allow the connecting gear 46 to elevate along the guide grooves 42 of the spin-mode shaft 40, there is provided elevating guide means comprising an elevating guide member 60 bolted or screwed to the fixing plate 58. The elevating guide member 60 is composed of two halves. Each of the halves is provided with an inclined elevating guide slit 61 having an opened lower end.

- 30 The elevating guide means further comprises an elevating ring 62 having elevating projections 63 which are formed to be inserted in the guide slits 61. The elevating

ring 62 is engaged with a stepped portion 50 of the connecting gear 46, interposing a bearing 65 therebetween. The bearing 65 is fixedly disposed on the projections 63 formed on an upper end of the elevating ring 62. The bearing 65 prevents the transmission of drive from the elevating ring 62 to the connecting gear 46 and vice

5 versa.

Coupled to the elevating projections 63 is an elevating gear 66 which enables the elevating projections 63 to elevate along the elevating guide slits 61, thereby guiding the elevating operation of the connecting gear 46.

10

The elevating gear 66 is provided with teeth 67 formed on the circumference thereof and a pair of grooves 68 formed so as to correspond to the elevating projections 63.

15

A rotating gear 69 for rotating the elevating gear 66 is engaged with the teeth 67 of the elevating gear 66. Connected to the rotating gear 69 by a connecting pin 70 is a connecting bar 71 through which drive from the drain motor (not shown) is transmitted.

20

The reversible motor 20 is a brushless direct current motor having the rotor 22 and a stator 21 disposed inside the rotor 22 as shown in Figure 3.

25

The coupling gear 53, engaged with the wash-mode shaft 45 of the transmission 30, is coupled on a central portion of the rotor 22. The rotor 22 comprises a housing inside of which a rotor core 24 is coupled. Permanent magnets 26 are mounted along an inner circumference of the rotor core 24. The stator 21 comprises a stator core 23 facing the magnets 26 and a coil 24 wound around the core 23.

30

The housing of the rotor 22 comprises a disc plate and a circumferential wall 91 formed on the circumference of the disc plate. The rotor core 24 and the magnets 26 are mounted on the inner surface of the circumferential wall 91. Heat radiating means for radiating heat generated in the stator when the motor 29 is operated is

provided on the inner face of the bottom of the housing of the rotor 22. The heat radiating means comprises a plurality of vanes 92 extending upward from the bottom of the housing and disposed in a radial direction so as to increase the flow speed of air generated in the stator 21 (See Figures 4 and 5).

5

Following washing, when electric power is applied to the washing machine, the rotating gear 69 is rotated by the drain motor (not shown) which is driven by an initial input current. By the rotation of the rotating gear 69, the elevating gear 66 rotates, rotating the elevating ring 62 engaged with the elevating gear 66.

10 Accordingly, the elevating projections 63 ascend along the elevating guide sills 61 of the elevating guide member 60 such that the elevating ring 62 ascends. As a result, the connecting gear 46 ascends along the guide grooves 42 of the spin-mode shaft 40 without rotating by the bearing 51 so that the outer teeth 47 of the connecting gear 46 is fixed by meshing with the inner teeth 59 of the fixing plate 58.

15

In the above state, after laundry has been placed in the spin basket 12 and water fed to the tub 11, when the electric current is applied to the motor 20, the rotor 22 of the motor 20 rotates in the clockwise and anti-clockwise directions. Here, the wash-mode shaft 45 and the coupling gear 53 rotate with the rotation of the motor 20, thereby rotating the agitator 13 coupled to the wash-mode shaft 45 and performing a washing/rinsing operation.

20 When the washing/rinsing operation is finished, the water in the tub 11 is drained by the opening of the drain valve 16 according to the operation of the drain motor (not shown).

25 After the water has been completely drained from the tub 11, the spin-drying operation is performed with the drain valve 16 open.

30 Referring to Figures 2, 3 and 5a, when the drain valve 16 is being opened by the drain motor (not shown), the transmission 30 changes to a spin-drying driving state. That

is, when the drain motor is operated, the drain valve 16 is opened, and at the same time, the rotating gear 69 rotates the elevating gear 66. By the rotation of the elevating gear 66, the elevating projections 63 descend along the elevating guide slits 61 of the elevating guide member 60, thereby lowering the elevating ring 62. As a 5 result, the connecting gear 46 descends along the guide grooves 42 of the spin-mode shaft 40, and the internal teeth 48 of the lowered connecting gear 46 mesh with the external teeth 74 of the coupling gear 53.

In this state, when power is applied to the reversible motor 20 so as to rotate the 10 rotor 22 at a high speed, the wash-mode shaft 45 and the connecting gear 46, engaged with the coupling gear 53, also rotate at high speed, thereby rotating the spin-mode shaft 40 at high speed. By this operation, the agitator 13 and the spin basket 12 rotate at a high speed such that the water retained in the laundry is forced out by the centrifugal force and drained through the drain hose 15.

15 When the motor 20 stops, electrical power is applied to the motor such that a reversed magnetic flux is generated in the coil 24 and, thus, reversed electromagnetic force is generated in the rotor 22. Therefore, the motor 20 generates reverse rotational force such that the rotating speed of the rotor 22 is rapidly reduced and 20 consequently the rotor 22 is stopped. This operation is controlled by a control portion of the washing machine.

In the above described motor 20, the radiating blades 92 prevent an increase in the temperature of the core 23, which is caused by generation of eddy current as the 25 varying magnetic force is applied to the core 23 of the stator 21 when the motor 20 is operated. That is, the radiating blades 92 radiate the heat generated by hysteresis losses and the generation of eddy currents.

While the invention has been described in connection with what is presently 30 considered to be most practical and preferred embodiments, it is to be understood

that the invention is not limited to the disclosed embodiments, but, on the contrary, it is intended to cover various modifications and equivalent arrangements.

Claims

1. An electric motor comprising a dish-shaped rotor and a stator located within the rotor, wherein the rotor is provided with vane means for directing cooling air to the stator.
5
2. A motor according to claim 1, wherein the vanes are arranged about the axis of rotation of the rotor and each vane projects axially from the rotor and has a major face directed tangentially with respect to the axis of rotation of the rotor.
10
3. A motor according to claim 1 or 2, wherein the rotor comprises a disc portion having an axially extending wall around its circumference and the vanes project from the disc portion.
15
4. A brushless dc motor according to claim 1, 2 or 3.
15
5. A washing machine including a motor according to any preceding claim, a tub, a spin basket within the tub, an agitator and transmission means for transferring drive from the motor to the spin basket and the agitator.
20
6. A motor for a washing machine, comprising:
a stator; and
a rotor disposed around the stator,
wherein said rotor is disk-shaped having a heat-radiating member for radiating heat
25 by directing air generated by rotation of the rotor to the stator.
25
7. A motor of claim 6, wherein the heat-radiating member comprises a plurality of radiating blades extending upward from the bottom of the rotor and disposed in a radial direction.
30

8. A motor substantially as hereinbefore described with reference to Figures 1 to 5 of the accompanying drawings.

9. A washing machine substantially as hereinbefore described with reference to Figures 1 to 5 of the accompanying drawings.



The
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Application No: GB 9800859.2
Claims searched: 1-9

Examiner: John Cockitt
Date of search: 27 May 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H2A [AKK4]

Int Cl (Ed.6): H02K [9/06, 01/32]; D06F [13/02]

Other: OPTICS: H2A (AK215*+AK211)

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP0750387A1	YANG	1 at least
X	US4659951A	GMCo	1 at least

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